ENERGY-SAVING METHOD FOR ELECTRICAL MACHINE AND SPECIAL DEVICE FOR CARRYING OUT THE SAME

FIELD OF THE INVENTION

The present invention relates to an energy-saving method for an electrical machine and a special device for carrying out this method, and belongs to the area of energy-saving electrical machine technology.

PRIOR ART

Conventional electrical machine often consumes a lot of electric energy at present. To reduce the consumption of the electric energy, people managed to delay the start-up of the electrical machine or adjust the input power factor of the electrical machine. Accordingly, the energy-saving devices for carrying out these methods typically involve a time delay control circuit, a switch control circuit, and a self-bridged program control circuit, wherein the self-bridged program control circuit consists of multiple sets of relays and button switches. Thanks to the fast conducting of the current and the slow releasing of the relay, a closed path is realized to provide electric power for the operation of the contacts of the relay. The relay keeps its normally-closed contacts in a self-holding mode after being stuck, and then the normally-closed contacts disconnects so as to separate the relay from the original power supply loop to realize an insulation effect. However, this type of conventional device uses multiple sets of relays as time-delay control elements for the start-up of the electrical machine, and the relays are elements that are easily spoiled or malfunction, so this will cause the

electrical machine out of order. In case a three-phase electrical machine is in use, the above problems may attack the electric network, that's even worse, the electrical machine is probably damaged in case the relay contacts are adhered to each other.

SUMMARY OF THE INVENTION

The main object of the present invention is to provide an energy-saving method for an electrical machine and special device for carrying out the energy-saving method for the electrical machine, which makes AC electrical machine of various types be switched on or off periodically so as to keep the rotating speed of the electrical machine constant, thereby saving the electric energy.

The object of the present invention is accomplished by an energy-saving method for an electrical machine, characterized in that the method includes a step of providing a control device in a power supply loop of an electrical machine to switch on or off the power supply periodically so as to keep the rotation speed of the electrical machine substantially constant, by utilizing inertia of a load during the rotation, in order to save the electric energy.

A special device for carrying out the energy-saving method of the electrical machine as described above has a structure characterized in that it comprises a pulse signal circuit, a photoelectric control circuit and a rectifier and filter circuit in electric connection; an input of the pulse signal circuit is connected with an output of the rectifier and filter circuit, and an output of the pulse signal circuit is connected with an input of the photoelectric control circuit ;

a control signal output of the photoelectric control circuit is connected in series with the positive power input of the electrical machine; the pulse signal circuit automatically generates pulse signal with adjustable width and frequency and send it to a control terminal of the photoelectric control circuit so as to control the on/off of the power supply of the electrical machine through the on/off operation of the photoelectric control circuit .

The object of the present invention is also accomplished by providing circuits as follows.

A pulse signal circuit consists of a pulse chip IC4, an adjustable resistor RP1, resistors R1~ R3 and a capacitor C4 in electrical connection, wherein the RP1, R1, and C4 constitute an RC oscillating circuit in connection with an oscillating input of the pulse chip IC4 and the R2 and R3 each has one end thereof in connection with to one output of the pulse chip IC4 and another end thereof in a short connection with each other; the photoelectric control circuit consists of a photoelectric coupling chips IC, thyristors SCR, adjustable resistors RP, resistors R, and capacitors C in electrical connection, wherein inputs of the IC are in connection to the short connection point of the R2 and R3, an output of the IC is connected to a control signal input of the SCRs, and the SCRs are connected in the power supply loop of the AC electrical machine in series, each of the resistors R and each of the capacitors C are connected in series crossing two ends of each of the SCRs; the power supply circuit consists of a transformer L, a bridge rectifier circuit VD, capacitors C1-C3 and a 12V DC voltage regulation chip IC5 in electrical connection.

The pulse signal circuit 1 consists of a pulse chip IC4, an adjustable

resistor RP1, resistors R1-R3 and a capacitor C4 in electrical connection, wherein the RP1, R1 and C4 constitute an RC oscillating circuit in connection with an oscillating input of the pulse chip IC4 and the R2 and R3 each has one end thereof in connection with one output of the pulse chip IC4 and another end thereof in a short connection with each other; the photoelectric control circuit 2 consists of a photoelectric coupling chips IC1-IC3, thyristors SCR1-SCR3, adjustable resistors RP1-RP3, resistors R4-R9, and capacitors C5-C7 in electrical connection , wherein inputs of IC1, IC2 and IC3 are connected at the short connection point of the R2 and R3, outputs of IC1, IC2 and IC3 are respectively connected to control signal inputs of the SCR1-SCR3, and the SCR1-SCR3 are respectively connected in the power supply loop of the 3-phases AC electrical machine in series, R7 and C5 are connected in series crossing two ends of the SCR1, R8 and C6 are connected in series crossing two ends of the SCR2, and R9 and C7 are connected in series crossing two ends of the SCR3; the power supply circuit consists of a transformer L, a bridge rectifier circuit VD, capacitors C1-C3 and a12V DC voltage regulation chip IC5.

The advantages of this invention are as follows:

1. By using the inertia of the load of the electrical machine, the rotation speed of the load will be kept constant for a period of time after the power supply loop is turned off, therefore the power supply can be turned off during this period. By adjusting the ratio of the on/off-time and the on/off frequency of the power supply based on the load of the electrical machine, the power supply of the electrical machine can be switched between on and off continuously and regularly, with no power consumption in the power supply off mode. According

to the present invention, as the bidirectional thyristors are connected in series with the power supply input, the on-time of the power supply loop is three to four times of the off time, and due to the inertia of the load of the electrical machine, the rotation speed is kept constant, thus the electrical machine is able to operate while the energy consumption is lessen.

2. As the pulse signal circuit and the photoelectric control circuit generally consist of IC chips, resistors and capacitors, and no easily-spoiled elements such as relays and buttons are used, a stepless adjustment could be accomplished, which can conveniently adjust the ratio of on/off-time of the photoelectric control circuit. The present invention has a simple circuit structure, which is safe, reliable, easy to be operated and adjusted, low cost, and applicable in various electrical machines.

3. When the load of the electrical machine is heavy and the inertia of the load is correspondingly big, the frequency of the on/off switching of the pulse signal can be increased, reversely, when the load is light and the inertia of the load is correspondingly small, the frequency of on/off switching of the pulse signal can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of the present invention;

Fig. 2 is a schematic diagram of a first embodiment of the present invention;

Fig. 3 is a pulse waveform diagram of the outputs a, b and Q of the IC4 in Fig.1; and

Fig. 4 is a schematic diagram of a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figures 1, 2 and 3 illustrate a first embodiment according to the present invention. As shown in Fig.1, the present invention has a pulse signal circuit 1, a photoelectric control circuit 2, and a power circuit 3 in electrical connection. An input of the pulse signal circuit 1 is connected with an output of the rectifier and filter circuit 3, and an output of the pulse signal circuit 1 is connected with an input of the photoelectric control circuit 2. Control signal outputs of the photoelectric control circuit 2 are connected with the positive power input of an electrical machine M in series.

The electrical machine M is a three-phase AC electrical machine according to the embodiment of the invention, as shown in Fig. 2. The pulse signal circuit 1 consists of a pulse chip IC4, an adjustable resistor RP1, resistors R1-R3 and a capacitor C4 in electrical connection, wherein the RP1, R1, and C4 constitute an RC oscillating circuit in connection with an oscillating input of the pulse chip IC4, and R2 and R3 each has one end thereof in connection with one output of the pulse chip IC4 and another end thereof in a short connection with each other. The photoelectric control circuit 2 consists of a photoelectric coupling chips IC1-IC3, thyristors SCR1-SCR3, adjustable resistors RP1-RP3, resistors R4-R9, and capacitors C5-C7 in electrical connection, wherein inputs of IC1, IC2 and IC3 are connected to the short connection point of the R2 and R3, outputs of IC1, IC2 and IC3 are respectively connected to control signal inputs of

the SCR1-SCR3, the SCR1-SCR3 are respectively connected in the power supply loop of the AC electrical machine in series, R7 and C5 are connected in series crossing two ends of the SCR1; R8 and C6 are connected in series crossing two ends of the SCR2; and R9 and C7 are connected in series crossing two ends of the SCR3. The power supply circuit 3 consists of a transformer L, a bridge rectifier circuit VD, capacitors C1-C3 and a 12V DC voltage regulation chip IC5 in electrical connection. Parameters of each of the elements used in this embodiment are shown in the following tables.

Table 1

Element	Model	Parameter
VD1-4	IN4005	400V/20mA
R1	Carbon film	5.6K
R2	Carbon film	200 Ω
R3	Carbon film	200 Ω
R4	Common	300 Ω
R5	Common	300 Ω
R6	Common	300 Ω
R7	Common	300 Ω
R8	Common	300 Ω
R9	Common	300 Ω

Table 2

Element	Model	Parameter
RP1	Carbon film	20K
RP2	Common	1M

RP3	Common	1M
RP4	Common	1M
C1	Electrolysis	3300 μ /50V
C2	Common	0.33 μ /50V
C3	Common	0.1 μ /50V
C4	Terylene	0.1 μ /50V
C5~C7	Terylene	0.1 μ /50V

Table 3

Element	Model	Parameter
L	Common	20K
SCR	KK500	400V/500A
IC1~IC3	MOC3062	600V/5mA
IC4	4047	12V
IC5	7812	500MA/12V

The operation principle of the present invention will be described as follows.

It is well known that, due to inertia, the rotating electrical machine will keep on rotating for a period of time T when the power supply is turned off suddenly. Generally speaking, the value of the time T depends on the load of the electrical machine. If, when the rotating speed of the electrical machine has not been reduced notably after the power supply is turned off, the power supply of

the electrical machine is turned on again, the rotation speed of the electrical machine and the load thereof will substantially keep as original.

The operation principle of the power supply circuit 3 is that the transformer L transforms the AC power supply (220V or 380V) to an AC power supply of 12V to be rectified by the bridge rectifier circuit composed of D1-D4, then a full wave pulse DC voltage is obtained, which becomes a smooth DC voltage after passing through the capacitor C1, the smooth DC voltage is then regulated by the IC5, and a 12V DC voltage could be attained. The C2 and C3 can prevent a high frequency parasitic oscillation source from generating or eliminate the same.

The operation principle of the pulse signal circuit 1 will now be described in detail. The pulse signal circuit 1 includes a pulse chip IC4 and a RC oscillating network at the periphery of the IC4. Two outputs of the IC4 can respectively output two clock signals (a), (b) with different widths, wherein the clock signal (a) sent from the output pin No. 13 has an oscillating frequency F and the clock signal (b) sent from the output pin No.10 has an oscillating frequency of a half of F. The oscillating frequency F is determined by the RC oscillating network in connection with pin Nos. 1, 2 and 3, and are adjustable through the change of the adjustable resistor RP1. As the internal structure of the IC4 is associated with the connection relationship of the periphery oscillating network, the output pin No. 13 sends out an output pulse with an on-time T=2.2 (RP1+R3)*C4, wherein the value of T is changeable by adjusting the value(s) of the RP1, R3 or C4. Also, the on-time of output signal sent out from the output pin No.10 is twice as that of output signal from the output pin No.13. In practical

application, the output pin Nos. 13 and 10 are in short connection with each other (the Q point as shown in Fig. 1). As the on-time of output signal sent out from the output pin No.10 is twice as that of output signal sent out from the output pin No.13, the on-time of the output signal from the Q point is 3 times of the on-time of output signal from the output pin No.13, thereby the ratio of the on/off time of output of the IC4 is 3:1. In this embodiment, the on-time of the Q point is adjusted to be 0.75 second by adjusting the RP1, i.e. the off-time of which is 0.5 second, with its period being one second. That is to say, in one second, the Q point is on/off once.

Now the operation principle of the photoelectric control circuit 2 will be explained in detail. The pulse control signal sent out from the Q point passes through the photoelectric coupling chips IC1, IC2, and IC3, and respectively controls control ends of the bidirectional thyristors SCR1, SCR2 and SCR3, so that each of the SCR1-SCR3 is switched on and off once in one second, with the on-time being three times of the off-time. Since the SCR1-SCR3 are connected in series in the power supply loop, the electrical machine is switched on and off once in one second, with the on-time being three times of the off-time. In this way, the ratio of on/off-time and the frequency of the on/off switching of the thyristors SCR1, SCR2 and SCR3 could be adjusted based on the load of the electrical machine in order to keep the rotation speed of the electrical machine constant, thereby saving the power energy. In Fig.2, the SCR1-SCR3 are respectively in parallel connection with the R7 and C5, R8 and C6, R9 and C7 so as to constitute an over-voltage protection and RC absorption loop, which can effectively protect the thyristors SCR1, SCR2 and SCR3 from being broken

down.

Fig. 1, Fig. 3 and Fig. 4 illustrate a second embodiment of the present invention. As shown in Fig. 4, the embodiment of the electrical machine of the invention is a single phase AC electrical machine.

CLAIMS

1. An energy-saving method for an electrical machine, characterized in that a control device is provided in a power supply loop of the electrical machine to switch on or off the power supply periodically so as to keep the rotation speed of the electrical machine substantially constant, by utilizing inertia of a load during the rotation, in order to save the electric energy.

2. A device for carrying out the energy-saving method for the electrical machine in claim 1, wherein the device has a pulse signal circuit (1), a photoelectric control circuit (2) and a rectifier and filter circuit (3) in electrical connection; an input of the pulse signal circuit (1) is connected with an output of the rectifier and filter circuit (3), and an output of the pulse signal circuit (1) is connected with an input of the photoelectric control circuit (2); a control signal output of the photoelectric control circuit (2) is connected in series with the positive power input of the electrical machine; the pulse signal circuit (1) automatically generates pulse signal with adjustable width and frequency and sends the pulse signal to a control terminal of the photoelectric control circuit (2) so as to control the on/off of the power supply of the electrical machine through the on/off operation of the photoelectric control circuit (2).

3. The device for carrying out the energy-saving method for the electrical machine in claim 2, characterized in that the pulse signal circuit (1) consists of a pulse chip IC4, an adjustable resistor RP1, resistors R1~ R3 and a capacitor C4 in electrical connection, wherein the RP1, R1 and C4 constitute an RC oscillating circuit in connection with an oscillating input of the pulse chip IC4 and R2 and R3 each has one end thereof in connection with one output of the

pulse chip IC4 and another end thereof in a short connection with each other; the photoelectric control circuit (2) consists of photoelectric coupling chips IC, thyristors SCR, adjustable resistors RP, resistors R, and capacitors C in electrical connection, wherein inputs of the IC are in short connection with the short connection point of R2 and R3, outputs of the IC are connected to control signal inputs of the SCRs, and the SCRs are connected in the power supply loop of the AC electrical machine in series, each of the resistors R and each of the capacitors C are connected in series crossing two ends of each of the SCRs; the power supply circuit (3) consists of a transformer L, a bridge rectifier circuit VD, capacitors C1-C3 and a 12V DC voltage regulation chip IC5 in electrical connection.

4. The device for carrying out the energy-saving method for the electrical machine in claim 2, characterized in that the pulse signal circuit (1) consists of a pulse chip IC4, an adjustable resistor RP1, resistors R1-R3 and a capacitor C4 in electrical connection, wherein the RP1, R1and C4 constitute an RC oscillating circuit in connection with an oscillating input of the pulse chip IC4 and R2 and R3 each has one end thereof in connection with one output of the pulse chip IC4 and another end thereof in a short connection with each other; the photoelectric control circuit (2) consists of photoelectric coupling chips IC1-IC3, thyristors SCR1-SCR3, adjustable resistors RP1-RP3, resistors R4-R9 and capacitors C5-C7 in electrical connection , wherein inputs of IC1, IC2 and IC3 are connected to the short connection point of the R2 and R3, outputs of IC1, IC2 and IC3 are respectively connected to control signal inputs of the SCR1-SCR3, and the SCR1-SCR3 are respectively connected in the power supply loop of the

3-phase AC electrical machine in series, R7 and C5 are connected in series crossing two ends of the SCR1, R8 and C6 are connected in series crossing two ends of the SCR, and R9 and C7 are connected in series crossing two ends of the SCR3; the power supply circuit (3) consists of a transformer L, a bridge rectifier circuit VD, capacitors C1-C3 and a12V DC voltage regulation chip IC5.

ABSTRACT OF THE DISCLOSURE

The invention relates to an energy-saving method for an electrical machine and a special device for carrying out the same, characterized in that a control device is provided in a power supply loop of the electrical machine to switch on or off the power supply periodically so as to keep the rotation speed of the electrical machine substantially constant, by utilizing inertia of a load during the rotation, in order to save the electric energy. The device has a pulse signal circuit 1, a photoelectric control circuit 2 and a rectifier and filter circuit 3; an input of the pulse signal circuit 1 is connected with an output of the rectifier and filter circuit 3, and an output of the pulse signal circuit 1 is connected with an input of the photoelectric control circuit 2. A control signal output of the photoelectric control circuit 2 is connected in series with the positive power input of an electrical machine. The pulse signal circuit 1 automatically generates pulse signal with adjustable width and frequency and send it to a control terminal of the photoelectric control circuit so as to control the on/off of the power supply of the electrical machine through the on/off operation of the photoelectric control circuit. Advantageously, the present invention provides a reliable and simple structural electric circuit that is widely applicable in various electrical machines.